

## **6<sup>th</sup> Grade**

### **Reflection and Transmission of Light Lab**

**Summary:** Opaque, translucent, and transparent materials are explored by using a flashlight and 10 different 'shields'. Reflection in mirrors is studied as students use periscopes, study the Law of Reflection, reflect light onto a target, and observe how a mirror makes images appear backwards.

#### **Intended Learning Outcomes for 6<sup>th</sup> Grade:**

- 1a. Observe simple objects, patterns, and events, and report their observations.
- 1b. Sort and sequence data according to criteria given.
- 1d. Comparing things, processes, and events.
- 1i. Use data to construct a reasonable conclusion.
- 3a. Know and explain science information specified for the grade level.
- 3b. Distinguish between examples and non-examples of concepts that have been taught.
- 4a. Record data accurately when give the appropriate form.
- 4b. Describe or explain observations carefully and report with pictures, sentences, and models.
- 4c. Use scientific language in oral and written communication.
- 5a. Cite examples of how science affects life.

#### **Utah State Core Curriculum Tie:**

##### **Standard VI Objective 2:**

- b. Compare the reflection of light from various surfaces.
- c. Investigate and describe the refraction of light passing through various materials.

**Preparation time:** once periscopes and shield envelopes are made 20 min; to initially make periscopes and shield envelopes approximately 2 hours

**Lesson time:** 60 min

**Small group size:** works best with one adult for every 5 students

#### **Materials:**

- 1. Possible shield materials, each about the size of one piece of paper: wax paper, plastic transparency, white paper, white tissue paper, colored tissue paper, aluminum foil, cloth material, black trash bag, wire mesh, clear plastic bag, and piece of glass (microscope slide). Place one of each in a manila envelope and make one envelope for each group.
- 2. one or two flashlights per group
- 3. mirrors, at least three per group but the more the better
- 4. words and star page attachment from the website. Paper protractor page from the website. Cut the papers in half.

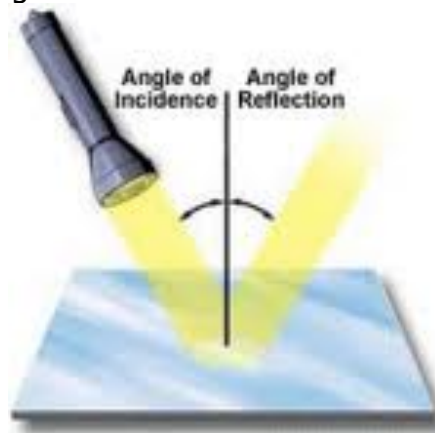
<http://beaconheights.slcschools.org/Grade6.php>

5. periscopes, at least one per group but one for every two students is ideal, directions for constructing inexpensive periscopes can be found on the website <http://beaconheights.slcschools.org/Grade6.php>

### **Background information:**

As light travels through matter, different amounts of that light penetrate through the matter. **Transparent** objects allow nearly all the light shined on it to pass through the object. Glass, air, and clear plastic are transparent objects. **Translucent** objects allow some of the light to pass through it while some of the light is absorbed. Wax paper and tissue paper are translucent and light that transmits through them is scattered and fuzzy. **Opaque** objects absorb or reflect all of the light and do not allow any light to pass through them. Brick, stone, and metals are opaque. Materials that are very dense tend to be opaque and objects that are not dense tend to be more transparent.

**Reflection** of light occurs when light hits a smooth surface that does not absorb any of the light but instead bounces it back off the surface. A mirror is flat, smooth, and polished. When light hits a mirror it is not absorbed but is reflected off at a very predictable angle. The angle that the light hits the mirror is called the angle of incidence. The angle of light that bounces off the mirror is called the angle of reflection. The Law of Reflection states that the angle of incidence is equal to the angle of reflection.



When light hits an object that is uneven, granular, or bumpy, the reflected light rays that bounce off scatter in many directions. These objects do not produce reflections that are recognizable like a mirror does.

When an image is reflected off a mirror, the image appears to the person seeing it as backwards. This can be observed when a word on a shirt or a paper is presented to the mirror and the person reading the word sees it as backwards. When a student tries to trace an image by looking in a mirror the brain needs to

switch what is seen from backwards to forwards. This is easier for some student's brains than others!

**Pre-lab discussion:** First, ask students to give examples of reflective surfaces. Have them explain what they think makes a surface reflective or not reflective. Use these comments to discuss the concept of reflection in the background information section. Second, ask students to define the three terms: transparent, translucent, and opaque. Have them give examples of materials they think belong to each category. Finally, show them the star page. Ask them if they think they would have any problems tracing that star. Tell them you will ask them again at the end of the class period!

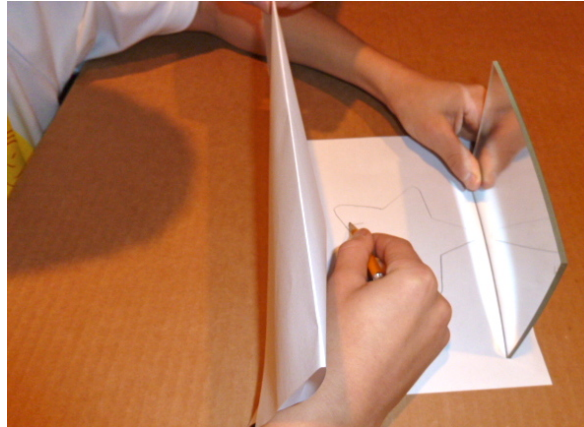
### **Instructional Procedure:**

#### **Activity 1: Transparent, Translucent, and Opaque Light Transmission**

1. Turn the lights off in the classroom. Take each of the 10 filters and the microscope slide from the filter envelope. Hold each filter separately between a flashlight and another white sheet of paper. Decide if the filters are transparent (nearly all light passes through easily onto the white paper), translucent (light is blurred or scattered on the paper), or opaque (light is blocked and does not reach the paper). Record this data on the answer sheet.

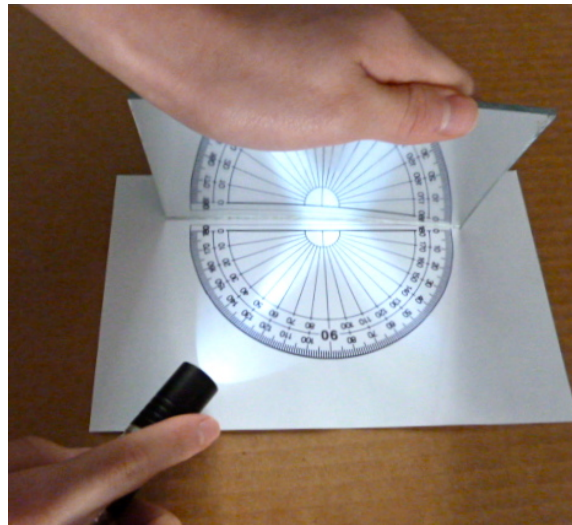
#### **Activity 2: Reflection off a mirror**

1. Take the paper with the words "BOXED SPIDERS". Point the words page towards a mirror and look at the reflection of the words in the mirror. The letters in the words appear backwards.
2. Now take the paper with the words "BOXED SPIDERS" and turn it upside down. Point the words page towards the mirror and again look at the reflection of the words in the mirror. The first word of each phrase appears correct because these letters look the same even when upside down. The other words appear upside down, but in the correct order, because the paper is turned upside down and the backwards letters have been corrected.
3. Hold the mirror vertically on the table so that it is facing the student. Place the star sheet on the bench in front of the mirror. Have another student place another piece of blank paper between the student's eyes and the star sheet so that the student can see the image of the star in the mirror but not on the paper. By looking in the mirror, have the student try and trace the star.



### Activity 3: Law of Reflection

1. Take a mirror and line it up along the zero line on the paper protractor. Shine a flashlight at the mirror from the  $30^\circ$  angle point on one side of the protractor. Make sure your flashlight is parallel to the table. Observe that the image is reflected onto the  $30^\circ$  angle point on the opposite side of the paper protractor. This confirms the Law of Reflection. Check this concept for other angles of incidence such as  $10^\circ$ ,  $60^\circ$ , and  $85^\circ$ .



2. Have one student hold the star picture they traced facing out in front of them. Point a flashlight away from the star picture and facing a mirror. Use two other mirrors and bounce the light in a way such that it reflects backwards and hits the star picture target. Try this with 4, 5, or 6 mirrors and see if you can reflect the light onto the star target each time.

**Activity 4: Reflection and the Periscope** 'Peri' means around and 'scope' means to look. A periscope allows sailors in a submarine to look above the surface of the water, while the submarine hides below the surface of the water.

1. Sit on the floor, facing away from the table or desk. Look into the **bottom** mirror of the periscope. Adjust the periscope mirrors so that you can see the reflection of the answer sheet lying on top of the table behind you in the **top** mirror. Notice the arrangement of the periscope mirrors that allowed you to read what is sitting on your desk. (The mirrors should be perpendicular to each other.) Make a diagram of the periscope on the answer sheet. Is the image you see in the periscope upside down?



2. Now sit at the table and arrange the mirrors so that when you look into the bottom mirror you can see the student sitting across from you in the top mirror. Notice the arrangement of the periscope mirrors that allowed you to see the person sitting across from you in the top mirror. (The mirrors should be parallel.) Make a diagram of the periscope on the answer sheet. Is the image you see in the periscope upside down?



3. Use your periscope to look around a corner, under a table, at the top of your head, or some other arrangement where a periscope is useful.